# PATENT SPECIFICATION

833,281

*Date of Application and filing Complete Specification: March 27, 1957.* *No. 10034/57.*

*Application made in Switzerland on April 27, 1956*

*Complete Specification Published: April 21, 1960*

Index at Acceptance:—**Class 80(2), S2(B5A:E:H).**

**International Classification:—F06d.**

COMPLETE SPECIFICATION

DRAWINGS ATTACHED

## Improvements in or relating to Turbo-compressor Rotor Assemblies

I, ALFRED JOHANN BUCHI, of Swiss nationality, of Archstrasse 2, Winterthur, Switzerland, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention concerns turbo-compressor rotor assemblies comprising a tubular rotatable support shaft and in which the turbine and compressor rotors are drawn axially one against the other by a co-axial tension member secured to the turbine rotor and extending through the support shaft. According to this invention the support shaft is provided with a cylindrical flange which is axially clamped to the compressor rotor by screw-threaded coupling members. The turbine torque, however, is applied to the support shaft (and thence to the compressor rotor) independently of said screw-threaded coupling members by one or more driving elements. It is preferred that the screw-threaded coupling members comprise bolts, studs or the like which extends loosely through holes in said flange, the driving element being secured to said flange and having end portions projecting from each side thereof for engagement respectively with the turbine and compressor rotors, a smaller driving clearance being provided between the ends of the driving element and the turbine and compressor rotors which they engage than is provided between the bolts, studs or the like and said holes in the flange. So as to reduce heat transmission from the turbine rotor to the compressor rotor and to the support shaft the rotors are mounted on axially-spaced, narrow, annular surfaces provided on the flange.

It may be arranged that the turbine rotor and the compressor rotor are mounted on the support shaft in such manner that they are centred thereon, the centring surface exposed to less intense heat during operation encircling the corresponding surface on the other part which is exposed to more intense heat. For example, the flange of the support shaft may be proved with an annular stepped portion which is received by a bore in the compressor rotor, the stepped portion and the bore constituting centring surfaces whereby the compressor rotor is co-axially mounted on the shaft. On the other hand the turbine rotor is centred on the shaft by providing at one end of the hollow support shaft an inner cylindrical surface which receives a co-axial cylindrical stepped portion of the turbine rotor.

The tension coupling member for the rotors may be co-axially centred on the inner surface of the tubular support shaft by means (e.g. splines or the like) which are spaced axially of the shaft and project outwardly beyond the diameter of the tension member.

A turbo-compressor assembly in accordance with the present invention will now be described, by way of example only, with reference to the accompanying drawing which illustrates the assembly in axial section and which also shows, in perspective, a detail of construction of the assembly.

Referring to the drawing: the turbo-compressor assembly comprises the turbine rotor 1 and the compressor rotor or impeller 2. The turbo-compressor assembly is mounted on a tubular support shaft 5 which is mounted for free rotation within a fixed mounting 3 which, in the particular example illustrated, projects into the hub portion 4 of the compressor impeller 2. A tension coupling member 8 co-axial with the turbo-compressor rotor assembly draws the turbine rotor 1 axially against the compressor

impeller 2 as later described.

The support shaft 5 is provided with a flange 5*a* to which the impeller 2 is secured by bolts 6. The tension member 8 draws the turbine rotor 1 axially against the flange 5*a* which is secured to the compressor impeller 2 by the bolts 6. According to a feature of the present invention a driving element is provided to transmit the torque from the turbine rotor 1 to the support shaft 5 and thence to the compressor impeller 2. It is to be understood that the bolts 6 extend loosely through holes 5′ in the flange 5*a*, there being a clearance space S between the stem 6*a* of each bolt and the hole 5′. Accordingly it will be appreciated that the bolts 6 are provided only for the purpose of clamping the flange 5*a* axially to the impeller 2 of the compressor.

In the particular arrangement being described the driving element 7 (see the perspective sketch) comprises a pin having a cylindrical central portion which is received by, and secured to, the flange 5*a*. The end parts of the driving pin have opposite flat surfaces 7*a* which enter slots 1*b* and 2*b* formed respectively in the rotors of the turbine and of the compressor. Since the bolts 6 pass through the flange 5*a* with clearance and the surfaces 7*a* engage the slots 1*b* and 2*b* with less clearance torque is transmitted from the turbine rotor 1 to the compressor impeller 2 by the pins 7 so that the bolts 6 are not subject to shear.

The tension member 8 is screw-threaded at the end thereof remote from the turbine rotor and a nut 8*a* is mounted thereon, the nut 8*a* engaging a collar 8*b* which abuts spring members 9 which in turn engages a sleeve 9*a*. A bearing ring is located between the end face 5′ of the tubular shaft 5 and the sleeve 9*a*, the ring 10 being clamped to the shaft when the nut 8*a* is drawn up. The ring 10 is in axial-bearing engagement with a surface 10*a* of a bearing member. An axially extending driving pin 11 couples the ring 10 to the tubular shaft 5 so that the two of them rotate together. It will be appreciated that when the nut 8*a* is drawn up the turbine rotor 1 is pressed axially against the flange 5*a* and it will be observed that the area of contact between the turbine rotor 1 and the flange 5*a* is through a relatively narrow annular surface 1*a*. Similarly the connection between the flange 5*a* and the impeller rotor 2 due to tightening of the bolts 6 is through a relatively narrow annular surface 5*c* on the flange 5*a*. Both of said annular surfaces extend from the outer periphery of the flange 5*a* radially inwardly to approximately the outer edge on the holes 5′ through which the bolts 6 pass.

The tension member 8 is supported within the tubular shaft 5 at the axially spaced regions 8′. The regions 8′ are formed with splines or similar projecting members having the maximum diameter *d* which is greater than the diameter *d*′ of the tension member. The splines or projections engage the inner surface of the tubular shaft.

A feature of the present invention resides in the means which are provided to mount the turbine rotor 1 concentrically on the support shaft 5. The rotor comprises a boss having a cylindrical surface 1*c* which is formed with an annular groove 1*d*. The surface 1*c* is received within a cylindrical inner surface 5*d* on the shaft 5. The turbine impeller is co-axially mounted on the shaft 5 by providing a stepped portion having a cylindrical surface 5*b* on the shaft, the stepped portion being received by a bore 2*c* of the compressor impeller. With this arrangement for the turbine rotor and the compressor impeller it is arranged that the member of a pair of co-axial members which is received within the other of the pair is at a higher temperature during operation than said other member so that the inner member expands radially thereby to grip the encircling outer member.

WHAT I CLAIM IS:—

1. A turbo-compressor rotor assembly comprising a tubular support shaft for the assembly wherein the turbine and compressor rotors are drawn axially together by a co-axial tension member secured to the turbine rotor and extending through the tubular shaft characterised in that the support shaft has a flange to which the compressor rotor is secured by screw-threaded coupling means, and the torque of the turbine is transmitted, independently of the coupling means, by a driving element to the shaft and to the compressor rotor.

2. An assembly as claimed in claim 1 characterised in that bolts or the like are provided axially to clamp the impeller rotor to said flange, said bolts or the like passing through holes in the flange with clearance and in that the driving element is secured to the flange and is in driving engagement with the turbine and compressor rotors, the driving clearance between the driving element and the turbine and compressor rotors being less than said bolt clearance so that the torque is transmitted by the driving element to the support shaft and the compressor rotor exclusively of said bolts or the like.

3. An assembly as claimed in claim 1 or 2 characterised in that the tension member bears against the free end of the shaft through the agency of a resilient member.

4. An assembly as claimed in claim 1, 2 or 3 characterised in that the rotors are axially clamped to the flange through axially stepped narrow annular surfaces.

5. An assembly as claimed in claim 1,

2, 3 or 4 in which the turbine rotor and the compressor rotor are centred on the support shaft so that the centring surface on that one part which is exposed to less intensive heating during operation encircle the centring surface on that other part which is exposed to more intensive heating.

6. An assembly as claimed in claim 5 wherein the flange of the support shaft has a cylindrical stepped portion which is received within a bore in the compressor rotor, the stepped portion and the bore centring the compressor rotor on the support shaft.

7. An assembly as claimed in claim 5 or 6 wherein the end of the tubular support shaft which is next to the turbine rotor has an inner surface which receives the outer cylindrical surface of a boss on the rotor, the boss centring the rotor on the shaft.

8. An assembly as claimed in any preceding claim characterised in that the tension member is provided with axially-spaced peripheral surfaces of greater diameter than the tension member, said surfaces of greater diameter engaging the inner surface of the tubular shaft so that the tension member is co-axially mounted therein.

9. An assembly as claimed in any preceding claim wherein the driving element is a pin-like component each end of which has opposite flat surfaces to co-act respectively with the grooves formed in the turbine and compressor rotors for the transmission of torque from the turbine to the compressor rotor.

10. A turbo-compressor rotor assembly substantially as hereinbefore described and as illustrated in the accompanying drawings.

For the Applicant

GRAHAM WATT & CO.,

Chartered Patent Agents,

Bank Chambers,

329, High Holborn,

London, W.C.1.

Berwick-upon-Tweed: Printed for Her Majesty's Stationery Office, by The Tweeddale Press Ltd.—1960.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2., from which copies may be obtained

833,281 COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of the Original on a reduced scale.*